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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/719,294	11/21/2003	Richard Edward Matick	YOR920030324US1	3009

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EXAMINER	
PATEL, HETUL B	

ART UNIT	PAPER NUMBER
2186	

DATE MAILED: 06/14/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/719,294	MATICK ET AL.	
	Examiner	Art Unit	
	Hetul Patel	2186	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 03 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *05 June 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-26* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-6,11,13-18,23,25 and 26* is/are rejected.

7)☒ Claim(s) *7-10,12,19-22 and 24* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. This action is responsive to communication filed on June 05, 2006. This amendment has been entered and carefully considered. Claims 1 and 13 are amended, and claims 1-26 are presented again for examination.

2. Applicant's arguments have been fully considered but they are not persuasive.

3. The rejection of claims 1-6, 11, 13-18, 23 and 25 as in the previous Office Action is respectfully maintained and reiterated below for Applicant's convenience.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. Claims 1-6, 11, 13-18, 23 and 25-26 are rejected under 35 U.S.C. 102(e) as being anticipated by Wilkerson (USPN: 2005/0015555).

As per claim 1, Wilkerson teaches a method allowing a choice of Least Frequently Used (LFU) or Most Frequently Used (MFU) cache line replacement (i.e. allowing LFU cache replacement algorithm), the method comprising the steps of: determining new state information (i.e. new number of times the cache line being

read/hit) for at least two given cache lines of a plurality of cache lines in a cache (i.e. *at least two* cache lines have to be examined to find out which cache line is the most frequently used compare to other cache line(s)), the new state information based at least in part on prior state information for the at least two given cache lines (i.e. new number of times the cache line being read/hit is always based on the prior number of hits); and when an access miss occurs in one of the at least two given lines: selecting either LFU or MFU replacement criteria (i.e. selecting the MFU replacement criteria), wherein the selection is based on a selection signal (i.e. based on the access miss indication/signal); and replacing one of the at least two given cache lines based on the new state information and the selected replacement criteria (e.g. see paragraph [0022]).

As per claim 2, Wilkerson teaches the claimed invention as described above and furthermore, Wilkerson teaches that the step of selecting further comprises the step of selecting either LFU or MFU replacement criteria based on selection information (i.e. based on counters 220-230 in Fig. 2).

As per claims 3 and 6, Wilkerson teaches the claimed invention as described above and furthermore, Wilkerson teaches that the state information comprises a plurality of line use counters (220-230 in Fig. 2), each line use counter corresponding to one of the plurality of cache lines (i.e. 310 in Fig. 3); and the step of determining new state information further comprises the step of incrementing a given line use counter when a cache line corresponding to the given line use counter is referenced (e.g. see paragraph [0022] and Figs. 2-3).

As per claim 4, Wilkerson teaches the claimed invention as described above and furthermore, Wilkerson teaches that the reference to the cache line corresponding to the given line use counter is a hit reference (i.e. the counter is incremented each time the cache line is referenced and set to zero when the cache line is replaced) (e.g. see paragraph [0022]).

As per claim 5, Wilkerson teaches the claimed invention as described above and furthermore, Wilkerson teaches that the plurality of cache lines (i.e. 310 in Fig. 3) are assigned to a plurality of congruence classes (i.e. SET 1 – SET M in Fig. 1), each congruence class assigned to at least two of the plurality of cache lines (i.e. blocks 1-N in Fig. 1) (e.g. see paragraph [0011] and Fig. 1), whereby at least two of the line use counters (i.e. 220-230 in Fig. 2) corresponds to a congruence class (e.g. see paragraph [0016] and Fig. 2); the state information further comprises a plurality of congruence class use counters (220-230 in Fig. 2); and the step of determining new state information further comprises the step of incrementing a given one of the plurality of congruence class use counters when a congruence class corresponding to the given congruence class use counter is referenced, wherein each of the plurality of congruence class use counters corresponds to one of the congruence classes (e.g. see paragraph [0022]).

As per claims 11 and 23, Wilkerson teaches the claimed invention as described above and furthermore, Wilkerson teaches that the cache (i.e. 110 in Fig. 1) is an n-way set associative cache, whereby there are n cache lines per congruence class (i.e. set) (e.g. see paragraph [0011] and Fig. 1).

As per claims 13-16, see arguments with respect to the rejection of claims 1-4, respectively. Claims 13-16 are rejected based on the same rationale as the rejection of claims 1-4, respectively.

As per claim 25, Wilkerson teaches a cache (i.e. 110 in Fig. 1) for replacing Most Frequently Used (MFU) cache lines, the cache comprising: a plurality of cache lines (i.e. 310 in Fig. 3); state information (i.e. the number of times the cache line being read/hit) for at least two given cache lines of the plurality of cache lines (i.e. each cache line has a counter, 220-230, associate with it to indicate how many times it is being referenced; see Figs. 2-3), wherein the state information includes at least one relative MFU count (i.e. the number of times the cache line being read/hit); MFU circuitry adapted: to produce new state information (i.e. new number of times the cache line being read/hit) for the at least two given cache lines in response to an access to one of the at least two given cache lines (i.e. *at least two* cache lines have to be examined to find out which cache line is the most frequently used compare to other cache line(s)) and to maintain said at least one relative MFU count to indicate a frequency of use of at least one of said given cache lines relative to one or more of said given cache lines (i.e. each cache line has a counter, 220-230, associate with it to indicate/maintain how many times it is being referenced; see Figs. 2-3); and when a cache miss occurs in one of the at least two given cache lines to determine, based on the new state information, which of the at least two given cache lines is the most frequently used cache line; and replacement circuitry coupled to the MFU circuitry and to the plurality of cache lines, the replacement

circuitry adapted to replace the given cache line determined as the most frequently used (e.g. see paragraphs [0016] and [0022] and Figs. 2-3).

As per claim 26, Wilkerson teaches the claimed invention as described above and furthermore, Wilkerson teaches that the MFU circuitry is further adapted to adjust said at least one relative MFU count when said at least one relative MFU count exceeds a maximum threshold (e.g. see paragraph [0016]).

Allowable Subject Matter

5. Claims 7-10, 12, 19-22 and 24 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Remarks

6. As to the remark, Applicant asserted:

(a) Wilkerson does not disclose or suggest a single embodiment where both LFU and MFU techniques are utilized and, thus, Wilkerson does ***not*** disclose or suggest selecting either LFU or MFU replacement criteria, as would be apparent to a person of ordinary skill in the art. Thus, Wilkerson does not disclose or suggest selecting either LFU or MFU replacement criteria *based on a selection signal*, as required by independent claims 1 and 13.

(b) Wilkerson teaches to use a MFU technique for *identifying a likely* ***Prefetch*** *line*; Wilkerson does ***not*** disclose or suggest utilizing a MFU technique to *identify a* ***replacement*** *line*.

(c) The embodiments disclosed by Wilkerson will not maintain a relative MFU count to indicate the frequency of use of a cache line relative to one or more other cache lines in cases where, for example, the usage count exceeds the maximum count or saturation count of the MFU counter. Independent claim 25 requires wherein said state information includes at least one relative MFU count; and MFU circuitry adapted to produce new state information for the at least two given cache lines in response to an access to one of the at least two given cache lines and to maintain said at least one relative MFU count to indicate frequency of use of at least one of said given cache lines relative to one or more of said given cache lines.

Examiner respectfully traverses Applicant's remark for the following reasons:

With respect to (a), Wilkerson does teach about selecting either LFU or MFU replacement criteria *based on a selection signal* (i.e. based on the access miss indication/signal). Since the current claim does not specify how and where the *a selection signal* is generated and how it is different from the access miss indication/signal, the access miss indication/signal of Wilkerson reads on it.

With respect to (b), as clearly disclosed in the title and the abstract of the Wilkerson prior art, the method and apparatus taught by Wilkerson is

determining/identifying a replacement line, i.e. a cache line that can be selected for replacement (e.g. see the abstract).

With respect to (c), Wilkerson does teach a counter to keep/maintain the MFU count for a given cache line. Wilkerson clearly discloses "One manner of determining the FRQ cache line may be to associate a counter, of a small number of bits, with each cache line in L1 cache 340. In one embodiment, the number of bits may be 8 or 16. The counter may be incremented each time the cache line is referenced, and may be set to zero when a cache line is replaced". (e.g. see paragraph [0022], lines 2-8).

Conclusion

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Hetul Patel whose telephone number is 571-272-4184. The examiner can normally be reached on M-F 8-4:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matt Kim can be reached on 571-272-4182. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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